

Building Envelope Applications for Reinforced Flexible Aerogel Insulation Blankets

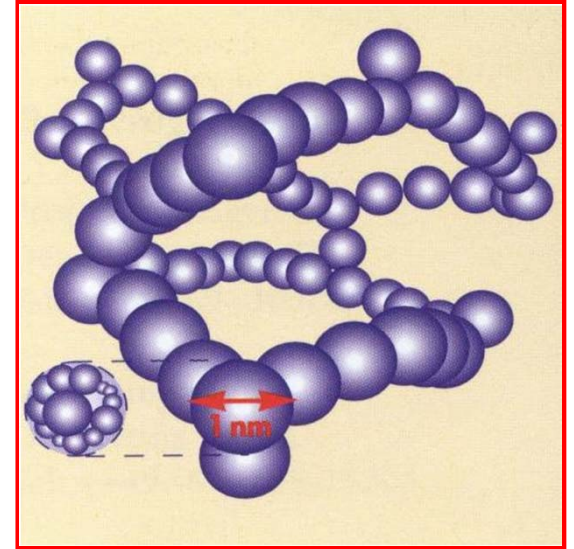
March 2011

Presenter: Stephen Harasim

Aspen Aerogels Inc.

What Is An Aerogel?

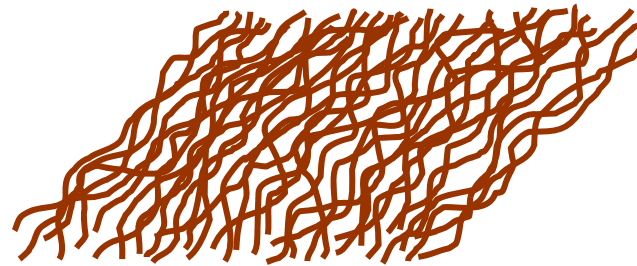
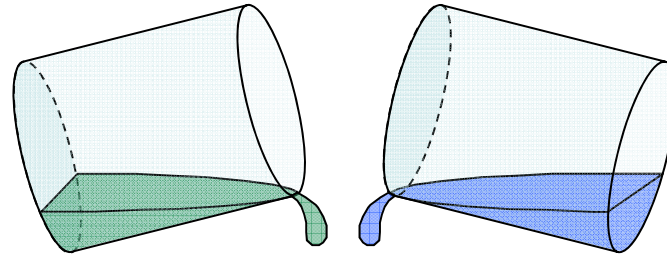
- Aerogels are nanoporous solids invented in the 1930's
 - Aerogels are created when silica is gelled in a solvent
 - *When the solvent is removed, what remains is “puffed-up sand”, with up to 99% porosity*
 - Nanopores cage the air molecules, retarding heat flow
 - Long molecular chains increase the solid path-length through the silica, reducing thermal conductivity
- Twin innovations helped move aerogels from lab curiosity to industrial product
 - Supercritical CO₂ extraction reduces cycle times from months to hours
 - Casting the wet gel into a fibrous batting provides mechanical integrity



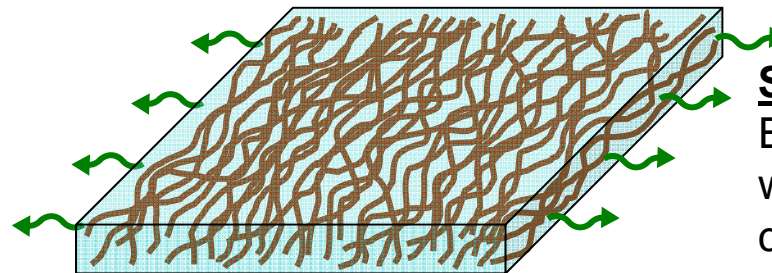
The Aerogel Advantage:
Superinsulation performance
in a flexible blanket form

Aerogel Thermal Performance – With the Flexibility of a Blanket

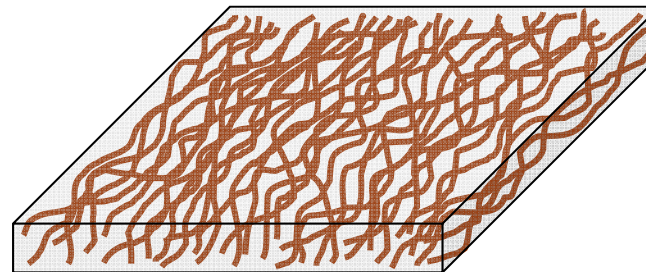
- Start with a non-woven blanket
 - Typically polyester, glass, carbon, or ceramic fiber
- Fill that blanket with a wet gel
- Remove the solvents via supercritical CO₂ extraction
- Roll the blanket onto a spool



Step 1:
Fill fibrous
batting with a
liquid-solid
solution



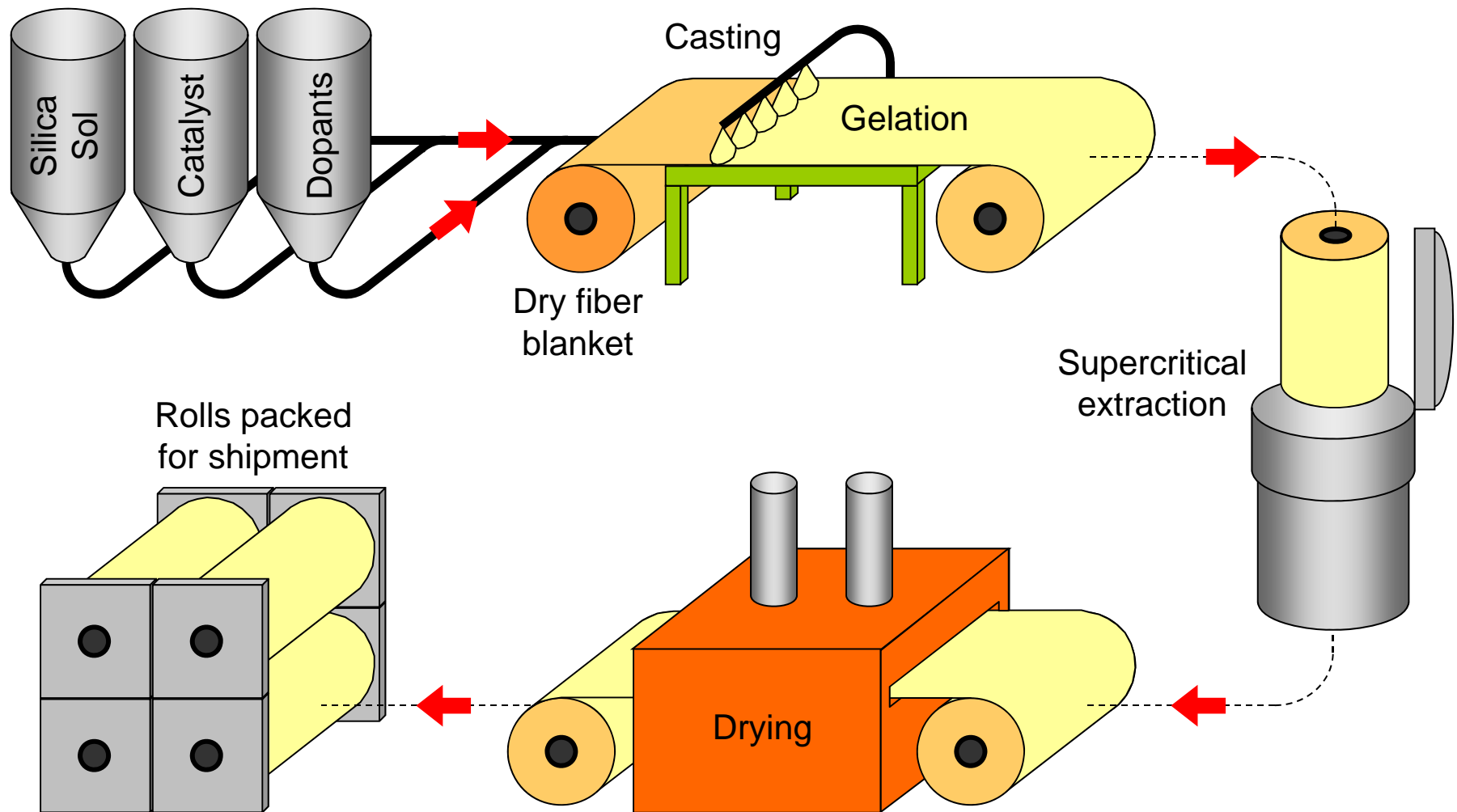
Step 2:
Extract solvents
with supercritical
carbon dioxide



Step 3:
Resulting dry,
fiber-reinforced
aerogel blanket



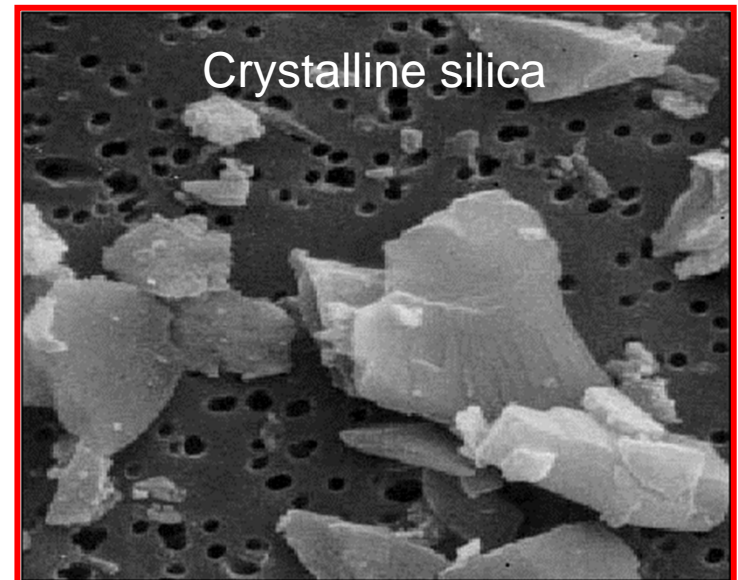
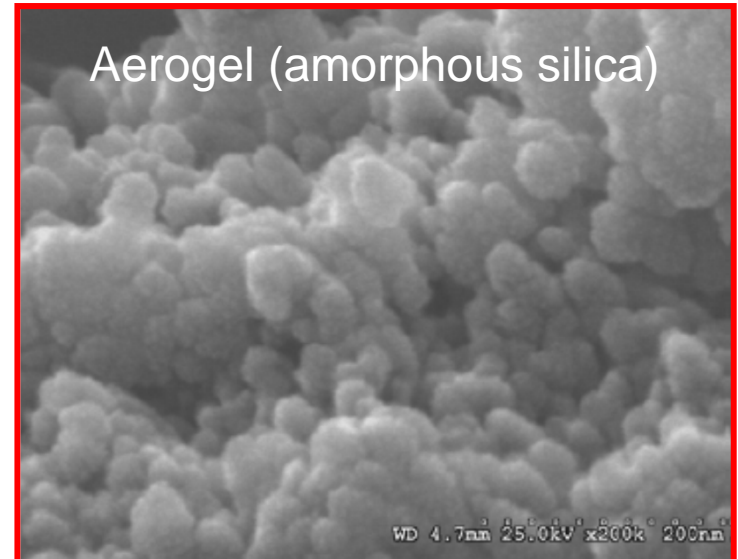
Aspen's Aerogel Manufacturing Process



Health and Safety Aspects of Aerogels

- Aerogels are an amorphous (non-crystalline) silica with 97% of particles larger than $45\mu\text{m}$
 - Only the *pores* are nano-scale ($\sim 0.01\ \mu\text{m}$)
 - Aerogel *particles* are much larger
- Amorphous silicas have been studied by OSHA, EPA, and the OECD, concluding:
 - “Demonstrated lack of toxicity, mutagenicity.”
 - “Is not expected to pose a carcinogenic risk.”
 - “Silicas are inert when ingested, and unlikely to be absorbed through the skin.”
 - “No concerns for human health.”
- Typical dust loading in fab-shop is $<5\ \text{mg}/\text{m}^3$
 - OSHA limit for amorphous silica is $80\ \text{mg}/\text{m}^3$

Recommended PPE is paper dust mask, work gloves, and safety glasses

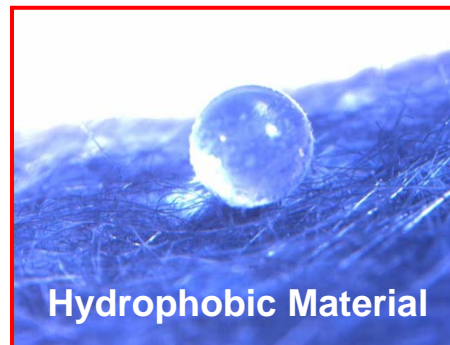


Spaceloft Technical Specifications and Sustainability

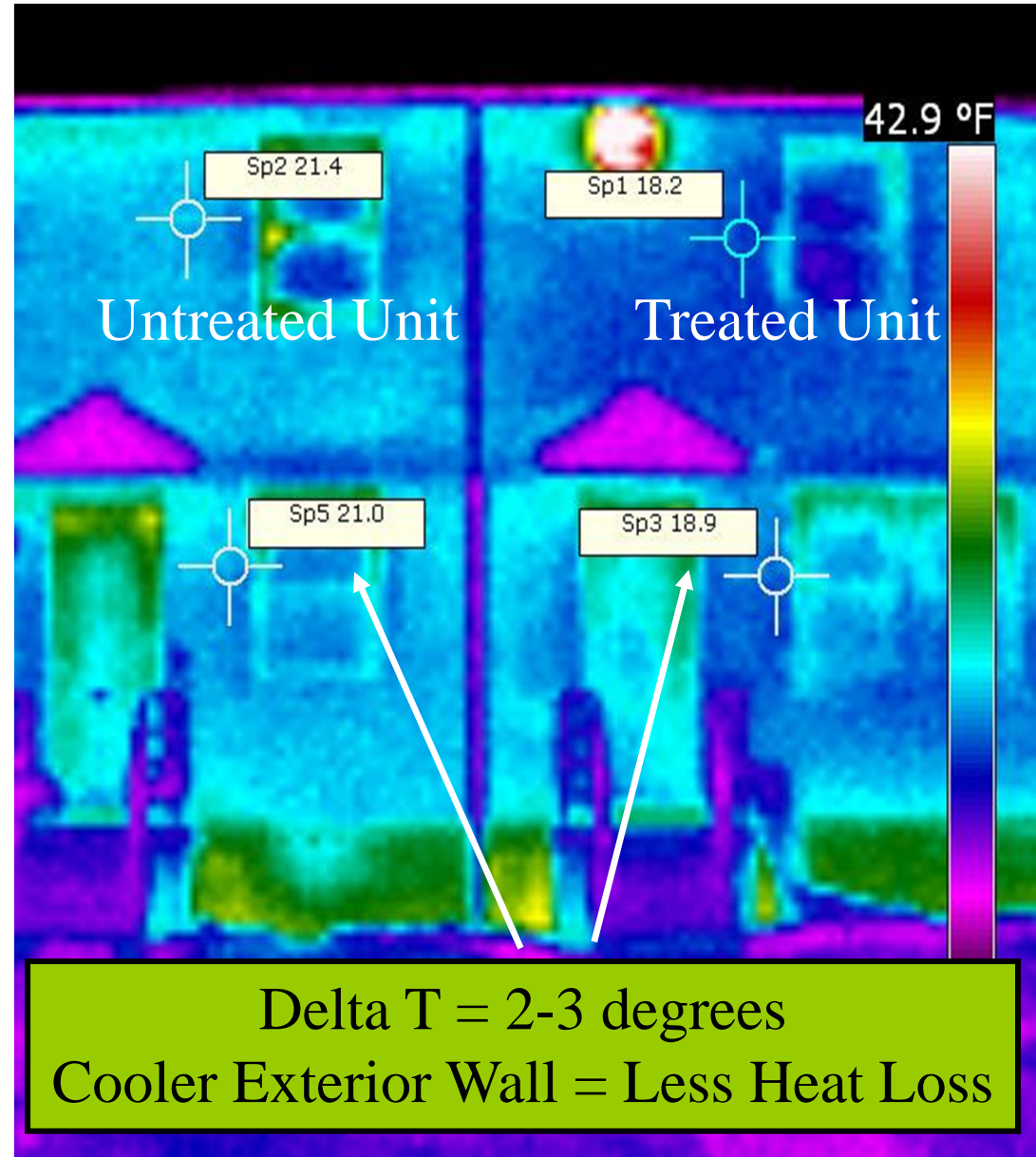
Test Procedure	Property	Results
ASTM C 518	Thermal Conductivity	0.094 BTU-in/hr-sqft-F
	R-value	R-10 installed @ 1" R-4 @ 0.4" (10 mm)
ASTM E 84	Flame Spread & Smoke Development	Class A: FSI <5 SDI 20
ASTM C 165	Compressive Strength	8psi @ 10% compression
ASTM E 96	Water Vapor Transmission Rate	79 perm
ASTM E 2178	Air Permeability	0.043 L / s-sqm
ASTM C 1338	Mold and Fungal Growth	0 growth
	Embodied Energy	22.8 kBTU / lb
	Embodied CO2	4.2 lb CO2 / lb

Material Attributes

- High thermal resistance per thickness
- Durable while flexible
- Stable thermal conductivity
- Prevents bulk water passage
- Readily passes water vapor
- Contains no ozone depleting substances
- >30% recycled content
- Recyclable



Interior Wall Application – Full Wall Coverage



Exterior Wall Application - Residential



Project : MA Housing Authority

Multi-Family renovation

Spaceloft insulation installed over new sheathing with new plank siding applied over the top

- Weather Resistive Barrier
- Continuous Insulation

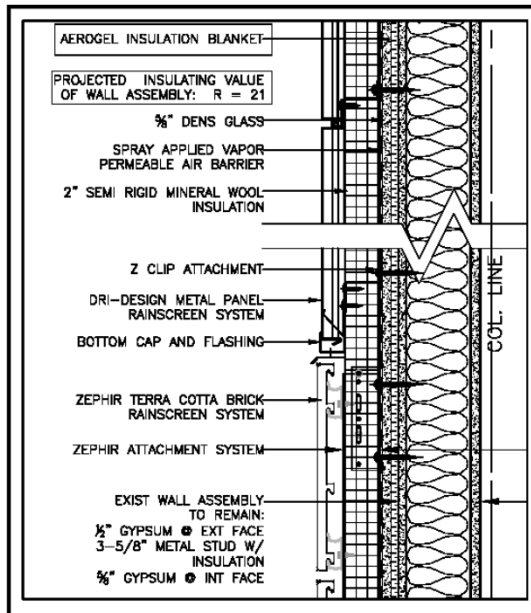
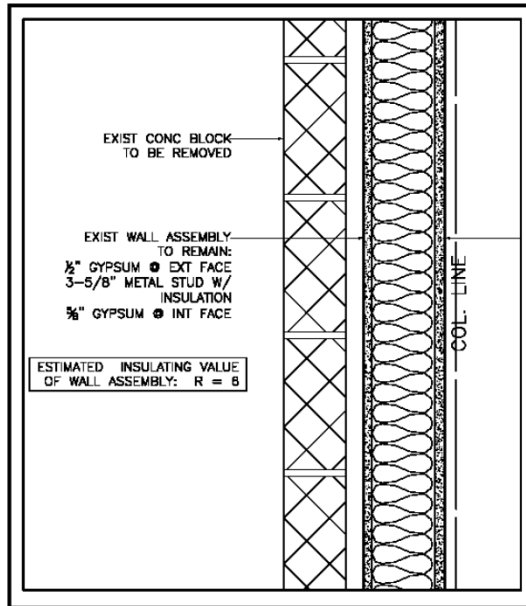
Project : Canadian Residential New Build

Spaceloft Insulation Applied over sheathing with WRB and new brick façade applied over the aerogel

- Continuous Insulation
- Energy Efficiency



Exterior Wall Application – “Façadetomy” & Stucco / EIFS



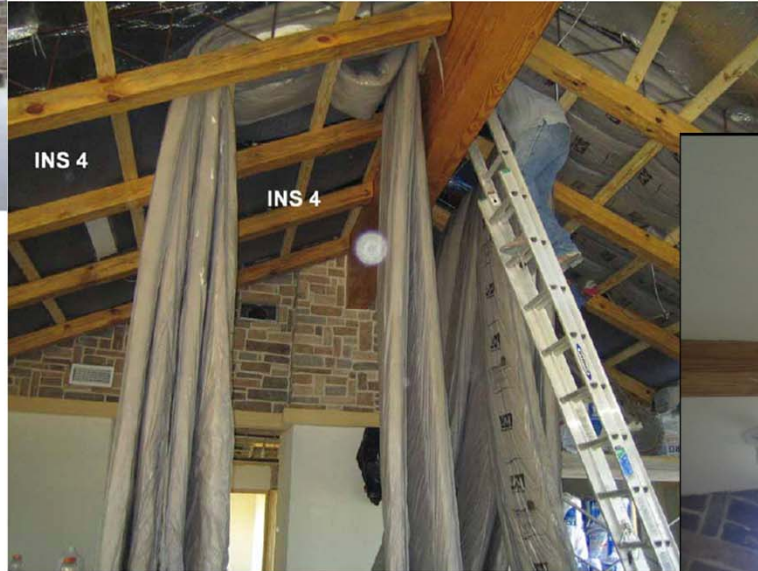
Cathedral Ceiling Application



Project : TX Cathedral Ceiling

Spaceloft insulation installed over ceiling framing
drywall installed over aerogel

- High R value
- Space Savings



Thermal Bridging Application



Project : CO Low Energy House

Spaceloft insulation strips applied to all exterior framing on residential new construction.

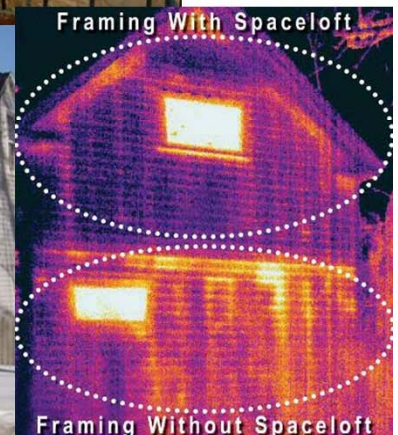
- Energy Efficiency
- Thermal Bridging



Project : MA Farmhouse Renovation

Spaceloft Insulation strips applied to all exterior framing on second story renovation

- Energy Efficiency
- Thermal Bridging



Passive House Application



Project : Portland Everhart Passive House Retrofit

Spaceloft insulation installed on framing and in walls

- Thermal Bridging
- Walls

Project : California O'Neill Passive House Retrofit

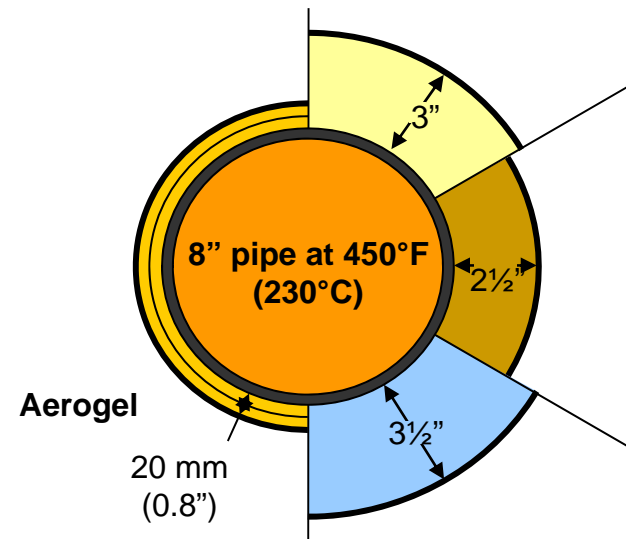
This is the first Passive House in California and the first retrofit Passive House in the entire country.

- Under floor
- Thermal Bridging



Specialty Applications

- Radiant Flooring
 - Thin profile
 - Improved Response Time
- Radiators & Convectors
- Curtain Wall and Window Framing
 - Thermal Break improvement
- Heat Protection
 - High Temperature Capability
- Distributed Energy
 - System Efficiency improvement
 - Maintenance Project EE opportunity



Ambient conditions = 75°F, no wind, 0.1 emissivity

For Further Information:

<http://www.aerogel.com>

Stephen Harasim
Aspen Aerogels Inc.
508-691-1141
sharasim@aerogel.com